ALPHA-GAMMA
TECHNOLOGIES, INC.

MEMORANDUM

DATE: December 18, 2007

SUBJECT: Cost Impacts and Emission Reductions Associated with Final NSPS for Stationary SI ICE and NESHAP for Stationary RICE

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TO: Jaime Pagán, EPA Energy Strategies Group

The purpose of this memorandum is to provide an estimate of the cost impacts and the emission reductions of the final new source performance standards (NSPS) for stationary spark ignition (SI) internal combustion engines (ICE). Costs associated with the final rule include the cost of installing and maintaining air pollution control equipment, the activities related to engine certification for manufacturers, and the cost of initial notification, recordkeeping, and testing for certain engine owners and operators. Costs and reductions as a result of the final standards under the National Emission Standards for Hazardous Air Pollutants (NESHAP) that are different than NSPS requirement are also presented.

The total estimated costs of the final NSPS for stationary SI engines are presented in Table 1. The costs include the annualized cost of purchasing, installing, operating, and maintaining applicable control technology, engine certification by engine manufacturers, initial compliance testing, notification, and recordkeeping. The capital cost of control of the NSPS is estimated to be $44 million in 2015. The total annual cost of the NSPS is estimated to be $19 million for the year 2015. The costs associated with the NESHAP for 250 to 500 horsepower (HP) 4-stroke lean burn (4SLB) SI engines located at major sources are presented in Table 2. The capital cost of control of the NESHAP was estimated to be $3 million for 2015. The total annual cost for these engines was calculated to be $3 million for the year 2015. The emission reductions associated with the implementation of the SI NSPS for the year 2015 are 77,000 tons of nitrogen oxides (NO_X), 45,000 tons of carbon monoxide (CO), 2,100 tons of volatile organic compounds (VOC), and 800 tons of hazardous air pollutants (HAP). An annual summary of the emission reductions for the SI NSPS is provided in Table 3. A more detailed breakdown of the reductions is provided in Appendix B. The emission reductions associated with controlling 250 to 500 HP 4SLB SI engines located at major sources are 990 tons of CO and 60 tons of HAP for the year 2015. A summary of the emission reductions from the NESHAP is presented in Table 4.

Table 1. Summary of Total Costs Associated with the SI NSPS[1]

Type of Cost	Total Annual Cost ($/yr)								
	2007	2008	2009	2010	2011	2012	2013	2014	2015
Control Capital Cost	1,711,331	31,708,085	40,401,068	41,032,563	41,664,057	42,295,552	42,927,046	43,558,541	44,190,035
Annual Control Cost	264,572	6,085,940	8,146,956	8,250,246	8,353,535	8,456,825	8,560,115	8,663,404	8,766,694
Engine Certification	23,085	172,247	180,390	184,093	187,797	191,501	195,205	198,908	202,612
Initial Compliance Test	680,012	7,694,421	7,655,743	7,784,150	7,912,557	8,040,964	8,169,371	8,297,777	8,426,184
Recordkeeping and Notification	175,236	1,078,725	1,100,108	1,116,689	1,133,269	1,149,849	1,166,429	1,183,009	1,199,589
Total Annual Cost	1,142,905	15,031,333	17,083,197	17,335,178	17,587,158	17,839,138	18,901,119	18,343,099	18,595,080

[1]Costs are calculated in year 2005 dollars.

Table 2. Summary of Population and Costs for New 250-500 HP 4SLB Engines Located at Major Sources[1]

	2007	2008	2009	2010	2011	2012	2013	2014	2015
Engine Population	341	350	360	369	379	388	398	407	416
Oxidation Catalyst Capital Cost	2,490,293	2,565,382	2,639,778	2,714,175	2,788,571	2,862,968	2,937,365	3,011,761	3,086,158
Oxidation Catalyst Annual Cost	435,315	448,441	461,446	474,450	487,455	500,460	513,465	526,470	539,475
Testing/ Monitoring Capital Cost	4,748,955	4,881,861	5,013,537	5,145,213	5,276,890	5,408,566	5,540,243	5,671,919	5,803,596
Testing/ Monitoring Annual Cost	2,099,490	2,158,247	2,216,460	2,274,674	2,332,887	2,391,101	2,449,314	2,507,528	2,565,741
Recordkeeping/ Reporting	53,201	54,690	56,165	57,640	59,115	60,590	62,065	63,540	65,015
Total Annual Cost	2,588,006	2,661,378	2,734,071	2,806,764	2,879,457	2,952,151	3,024,844	3,097,538	3,170,231

[1]Costs are calculated in year 2005 dollars.

Table 3. Summary of the SI NSPS Pollutant Emission Reductions

Year Range	NO_X (tons/year)	CO (tons/year)	VOC (tons/year)	HAP[1] (tons/year)
2007	9,078	3,534	149	56
2008	57,496	27,533	811	304
2009	61,695	29,338	828	311
2010	64,804	32,934	1,617	606
2011	71,850	42,083	1,979	742
2012	73,228	42,802	2,021	758
2013	74,606	43,521	2,062	773
2014	75,984	44,240	2,104	789
2015	77,362	44,959	2,146	805
2007-2015	566,102	310,945	13,717	5,144

[1]HAP emissions were calculated using the CH_2O/NMHC correlation factor developed in the memorandum “Non-methane Hydrocarbons as a surrogate for Hazardous Air Pollutants for Stationary Internal Combustion Engines (Reference 1).” HAP emissions were calculated by assuming that CH_2O is 72% of HAP emissions (Reference 2).
[2]Emission reduction estimates provided in this table are based on assumptions provided in the memorandum entitled "Cost of Control Per Ton Pollutant Reduced for Spark Ignited Internal Combustion Engines," available from the rulemaking docket as Document ID Number EPA-HQ-OAR-2005-0030-0060.

Table 4. Summary of Emission Reductions from New 250-500 HP 4SLB Engines Located at Major Sources

Year Range	CO (Ton/Year)	HAP[1] (Ton/year)
2007	795	69
2008	821	72
2009	843	74
2010	866	76
2011	892	78
2012	914	80
2013	936	82
2014	964	84
2015	986	86
2007-2015	8,017	701

[1]HAP emissions were calculated using the CH_2O/NMHC correlation factor developed in the memorandum "Non-methane Hydrocarbons as a surrogate for Hazardous Air Pollutants for Stationary Internal Combustion Engines (Reference 1)." HAP emissions were calculated by assuming that CH_2O is 72% of HAP emissions (Reference 2).

Total estimated control costs associated with the SI NSPS by North American Industry Classification System (NAICS) are presented in Table 5 for the following industries:

333912	Air and Gas Compressor Manufacturing
335312	Motor and Generator Manufacturing
333911	Pump and Pumping Equipment Manufacturing
333992	Welding and Soldering Equipment

A breakdown of the SI NSPS costs by HP range for each of the industries is presented in Appendix A. The tables in the appendix also include the costs for new 250-500 HP 4SLB engines located at major sources for each industry category.

Projected Number of New Engines

The projected number of new stationary SI ICE per year for the years 2007 through 2015 is presented in Table 6. The stationary SI engine inventory projections were previously developed in the memorandum, "Population and Projection of Stationary Engines (Reference 3)." The stationary SI engine projections in this memorandum were broken down into engine size ranges. The new engine projections were then divided into subcategories of SI engines based on engine manufacturer estimates of lean burn and rich burn engines. The lean burn and rich burn engines were then divided into fuel types using engine manufacturer estimates, which include natural gas, landfill/digester gas, gasoline, and propane. A new subcategory of SI engines was developed to account for SI engines used for emergency purposes. Based on information obtained from the EMA (Reference 4), emergency engines make up approximately 5 percent of the total SI population and are predominantly rich burn engines. Note that the projection population of new stationary SI engines was slightly revised after the proposal based on new information. For purposes of estimating impacts associated with the final rulemaking, EPA used the estimates presented in Table 6 of this memorandum and should be referred to as opposed to the projection population estimates presented in the memorandum cited above (Reference 3).

Cost Impacts

The cost impacts for stationary SI engines are varied due to the number of different engine types and fuels used by the engines. The types of engines include lean burn and rich burn engines firing fuels such as, natural gas, gasoline, propane, landfill gas and digester gas. The SI NSPS will establish emission standards for each of these subcategories. A summary of the final stationary SI NSPS emission standards is presented in Table 7. The cost impacts of the SI NSPS were calculated using the following parameters: annual cost for operating a control technology, cost of engine certification, cost of initial compliance testing, and cost of notification and recordkeeping. Each of these cost parameters is discussed for the subcategories in the following sections.

Table 5. Summary of Control Costs Associated with SI NSPS by NAICS[1]

	2007	2008	2009	2010	2011	2012	2013	2014	2015
333912									
Capital Control Cost	875,400	10,215,197	11,700,336	11,984,063	12,267,790	12,551,518	12,835,245	13,118,973	13,402,700
Total Annual Cost	583,718	3,921,648	4,184,173	4,276,847	4,369,521	4,462,195	4,554,869	4,647,544	4,740,218
335312									
Capital Control Cost	826,320	20,757,815	26,281,187	26,631,680	26,982,172	27,332,664	27,683,156	28,033,648	28,384,140
Total Annual Cost	552,775	10,186,260	11,509,288	11,660,644	11,812,000	11,963,356	12,114,712	12,266,068	12,417,424
333911									
Capital Control Cost	9,611	683,130	1,187,741	1,189,881	1,192,020	1,194,160	1,196,299	1,198,438	1,200,578
Total Annual Cost	6,412	606,947	756,378	764,640	772,902	781,163	789,425	797,687	805,949
333992									
Capital Control Cost	51,943	1,231,804	1,226,940	1,222,075	1,217,211	1,212,346	1,207,482	1,202,617	1,197,753
Total Annual Cost	316,478	633,359	633,047	632,736	632,424	632,113	631,801	631,489	631,178

[1]Costs are calculated in year 2005 dollars.

Table 6. Projected New SI Engines by Subcategory

HP Range	Natural Gas			Gasoline		Propane			Landfill Gas/Digester Gas		
	Prime 4SLB	Prime 4SRB	Emergency 4SRB	Prime 4SRB	Emergency 4SRB	Prime 4SLB	Prime 4SRB	Emergency 4SRB	Prime 4SLB	Prime 4SRB	Emergency 4SRB
2007 Engine Projection											
25-50	0	2,087	52	380	20	105	89	5	0	0	0
50-100	0	1,914	47	348	18	97	82	4	28	23	1
100-175	1,000	2,650	89	655	34	183	154	8	52	44	2
175-300	935	788	41	305	16	85	72	4	24	20	1
300-500	478	403	21	0	0	37	31	2	11	9	0
500-600	239	202	11	0	0	18	16	1	5	4	0
600-750	39	33	2	0	0	3	3	0	1	1	0
750-1200	551	464	24	0	0	42	36	2	12	10	1
1200-2000	410	130	7	0	0	32	10	1	9	3	0
> 2000	235	0	0	0	0	18	0	0	5	0	0
2008 Engine Projection											
25-50	0	2,161	53	393	21	109	92	5	0	0	0
50-100	0	1,906	47	347	18	97	81	4	28	23	1
100-175	1,000	2,656	89	656	35	163	154	8	52	44	2
175-300	948	799	42	309	16	86	73	4	25	21	1
300-500	496	418	22	0	0	38	32	2	11	9	0
500-600	248	209	11	0	0	19	16	1	5	5	0
600-750	35	29	2	0	0	3	2	0	1	1	0
750-1200	572	482	25	0	0	44	37	2	13	11	1
1200-2000	427	135	7	0	0	33	10	1	9	3	0
> 2000	242	0	0	0	0	19	0	0	5	0	0

Table 6. Projected New SI Engines by Subcategory (Continued)

HP Range	Natural Gas			Gasoline		Propane			Landfill Gas/Digester Gas		
	Prime 4SLB	Prime 4SRB	Emergency 4SRB	Prime 4SRB	Emergency 4SRB	Prime 4SLB	Prime 4SRB	Emergency 4SRB	Prime 4SLB	Prime 4SRB	Emergency 4SRB
2009 Engine Projection											
25-50	0	2,235	55	407	21	113	95	5	0	0	0
50-100	0	1,898	47	345	18	96	81	4	28	23	1
100-175	1,000	2,662	89	657	35	183	154	8	52	44	2
175-300	962	810	43	313	16	87	74	4	25	21	1
300-500	515	434	23	0	0	40	33	2	11	10	1
500-600	257	217	11	0	0	20	17	1	6	5	0
600-750	31	26	1	0	0	2	2	0	1	1	0
750-1200	594	500	26	0	0	46	38	2	13	11	1
1200-2000	445	141	7	0	0	34	11	1	10	3	0
> 2000	250	0	0	0	0	19	0	0	5	0	0
2010 Engine Projection											
25-50	0	2,038	57	420	22	116	98	5	0	0	0
50-100	0	1,890	47	344	18	96	81	4	27	23	1
100-175	1,000	2,668	90	658	35	184	155	8	52	44	2
175-300	975	821	43	318	17	89	75	4	25	21	1
300-500	533	449	24	0	0	41	35	2	12	10	1
500-600	267	225	12	0	0	21	17	1	6	5	0
600-750	27	23	1	0	0	2	2	0	1	0	0
750-1200	615	518	27	0	0	47	40	2	14	11	1
1200-2000	463	147	8	0	0	36	11	1	10	3	0
> 2000	258	0	0	0	0	20	0	0	6	0	0

Table 6. Projected New SI Engines by Subcategory (Continued)

HP Range	Natural Gas			Gasoline		Propane			Landfill Gas/Digester Gas		
	Prime 4SLB	Prime 4SRB	Emergency 4SRB	Prime 4SRB	Emergency 4SRB	Prime 4SLB	Prime 4SRB	Emergency 4SRB	Prime 4SLB	Prime 4SRB	Emergency 4SRB
2011 Engine Projection											
25-50	0	2,382	59	433	23	120	101	5	0	0	0
50-100	0	1,882	47	342	18	95	80	4	27	23	1
100-175	1,000	2,674	90	659	35	184	155	8	53	44	2
175-300	988	833	44	322	17	90	76	4	26	22	1
300-500	551	464	24	0	0	42	36	2	12	10	1
500-600	276	232	12	0	0	21	18	1	6	5	0
600-750	23	19	1	0	0	2	1	0	1	0	0
750-1200	636	536	28	0	0	49	41	2	14	12	1
1200-2000	480	152	8	0	0	37	12	1	11	3	0
> 2000	265	0	0	0	0	20	0	0	6	0	0
2012 Engine Projection											
25-50	0	2,455	61	447	24	124	104	5	0	0	0
50-100	0	1,874	46	341	18	95	80	4	27	23	1
100-175	1,000	2,680	90	660	35	184	155	8	53	44	2
175-300	1,002	844	44	326	17	91	77	4	26	22	1
300-500	570	480	25	0	0	44	37	2	13	11	1
500-600	285	240	13	0	0	22	18	1	6	5	0
600-750	19	16	1	0	0	1	1	0	0	0	0
750-1200	657	554	29	0	0	51	43	2	14	12	1
1200-2000	498	158	8	0	0	38	12	1	11	3	0
> 2000	273	0	0	0	0	21	0	0	6	0	0

Table 6. Projected New SI Engines by Subcategory (Continued)

HP Range	Natural Gas			Gasoline		Propane			Landfill Gas/Digester Gas		
	Prime 4SLB	Prime 4SRB	Emergency 4SRB	Prime 4SRB	Emergency 4SRB	Prime 4SLB	Prime 4SRB	Emergency 4SRB	Prime 4SLB	Prime 4SRB	Emergency 4SRB
2013 Engine Projection											
25-50	0	2,529	63	460	24	127	107	6	0	0	0
50-100	0	1,866	46	339	18	95	80	4	27	23	1
100-175	1,000	2,686	90	661	35	184	155	8	53	44	2
175-300	1,015	855	45	331	17	92	78	4	26	22	1
300-500	588	495	26	0	0	45	38	2	13	11	1
500-600	294	248	13	0	0	23	19	1	6	5	0
600-750	15	13	1	0	0	1	1	0	0	0	0
750-1200	678	571	30	0	0	52	44	2	15	13	1
1200-2000	516	163	9	0	0	40	13	1	11	4	0
> 2000	281	0	0	0	0	22	0	0	6	0	0
2014 Engine Projection											
25-50	0	2,602	64	473	25	131	110	6	0	0	0
50-100	0	1,858	46	338	18	94	79	4	27	23	1
100-175	1,000	2,692	90	662	35	185	156	8	53	44	2
175-300	1,028	866	46	335	18	93	79	4	27	22	1
300-500	606	511	27	0	0	47	39	2	13	11	1
500-600	303	255	13	0	0	23	20	1	7	6	0
600-750	11	9	0	0	0	1	1	0	0	0	0
750-1200	699	589	31	0	0	54	45	2	15	13	1
1200-2000	534	169	9	0	0	41	13	1	12	4	0
> 2000	288	0	0	0	0	22	0	0	6	0	0

Table 6. Projected New SI Engines by Subcategory (Continued)

HP Range	Natural Gas			Gasoline		Propane			Landfill Gas/Digester Gas		
	Prime 4SLB	Prime 4SRB	Emergency 4SRB	Prime 4SRB	Emergency 4SRB	Prime 4SLB	Prime 4SRB	Emergency 4SRB	Prime 4SLB	Prime 4SRB	Emergency 4SRB
2015 Engine Projection											
25-50	0	2,676	66	487	26	135	114	6	0	0	0
50-100	0	1,850	46	336	18	94	79	4	27	23	1
100-175	1,000	2,698	90	663	35	185	156	8	53	45	2
175-300	1,041	877	46	339	18	95	80	4	27	23	1
300-500	625	526	28	0	0	48	40	2	14	12	1
500-600	312	263	14	0	0	24	20	1	7	6	0
600-750	7	6	0	0	0	1	0	0	0	0	0
750-1200	720	607	32	0	0	55	47	2	16	13	1
1200-2000	551	175	9	0	0	42	13	1	12	4	0
> 2000	296	0	0	0	0	23	0	0	7	0	0

Table 7. Summary of Final Stationary SI NSPS

Engine Type and Fuel	Engine Size (HP)	Final SI NSPS	
SI Engines All Fuels	≤25	Meet 40 CFR part 90	
SI Engines Gasoline	>25[1]	Meet 40 CFR part 1048	
SI Engines Rich Burn Propane	>25[1]	Meet 40 CFR part 1048	
SI Engines Other Fuels	25-100[1]	Meet 40 CFR part 1048	
SI Engines Other Fuels[2]	>100	Stage 1	2.0 g/HP-hr NO_X 4.0 g/HP-hr CO 1.0 g/HP-hr VOC
		Stage 2	1.0 g/HP-hr NO_X 2.0 g/HP-hr CO 0.7 g/HP-hr VOC
SI Engines Landfill /Digester Gas	All sizes	3.0 g/HP-hr NO_X 5.0 g/HP-hr CO 1.0 g/HP-hr NMHC	
		2.0 g/HP-hr NO_X 5.0 g/HP-hr CO 1.0 g/HP-hr NMHC	
Emergency SI Engines All Fuels	25-130	10 g/HP-hr NO_x+HC 387 g/HP-hr CO	
	≥130	2.0 g/HP-hr NO_X 4.0 g/HP-hr CO 1.0 g/HP-hr VOC	
New and Reconstructed 4SLB Engines Located at Major Sources	250 – 500	93% CO Reduction or 14 ppmvd @ 15% O_2 Formaldehyde[3]	

[1]If the engine is ≤1,000 cc the engine can meet 40 CFR part 90, as appropriate.
[2]Lean burn LPG have the option of meeting standards in 40 CFR part 1048.
[3]Requirements under final NESHAP.

SI Engines > 25 HP – Gasoline and Rich Burn Propane

For SI engines greater than 25 HP firing gasoline and rich burn engines greater than 25 HP firing propane, the SI NSPS requires the engines meet the standards in 40 CFR part 1048. The cost impacts were calculated based on the requirement that the manufacturers would certify all engines. Certification values of $13 per engine for 25 to 300 HP engines, $32 for 300 to 600 HP SI engines, and $153 for greater than 600 HP engines were used to estimate certification costs. The certification values were obtained from Table 5.2.1-4 of the "Final Regulatory Support Document: Control of Emissions from Unregulated Nonroad Engines (Reference 5)" and converted to year 2005 dollars The NSPS impacts for this category of engines includes the cost of notification and recordkeeping, which was estimated to be one hour per year at $68 per hour.

SI Engines 25-100 HP – Other Fuels

For SI engines between 25 and 100 HP (except gasoline and rich burn LPG), the SI NSPS requires that engines either be certified by the engine manufacturer according to the requirements in 40 CFR part 1048, or that owners/operators show compliance by conducting an initial compliance test. It was estimated that the engine manufacturer would certify 50 percent of the engines in this category. A certification cost of $13 per engine was used to estimate the SI cost impacts for these engines. The certification cost value was obtained from Table 5.2.1-4 of the document, "Final Regulatory Support Document: Control of Emissions from Unregulated Nonroad Engines (Reference 5)." The certification costs in the regulatory support document were converted to Year 2005 dollars. This cost covers the cost of certifying the engine to the emission standards and includes the amortization of those costs over five years of engine sales. The NSPS impacts for this category of engines includes the cost of notification and recordkeeping, which was estimated to be one hour per year at $68 per hour.

SI Engines > 100 HP – Other Fuels

The SI NSPS requires that SI engines greater than 100 HP that are not gasoline or rich burn LPG engines meet the final Stage 1 and 2 emission standards for NO_x, CO, and VOC. This would include all natural gas engines, lean burn LPG engines, and other engines not using gasoline or rich burn engines using LPG. Most lean burn SI engines will be able to meet the NSPS standards without using any type of emission control technology. The other lean burn SI engines should be able to meet the standards by using combustion modifications to reduce pollutant emissions. Therefore no control costs were calculated for natural gas fired lean burn engines. The cost impacts for natural gas fired lean burn SI engines were calculated assuming that the engine manufacturers would certify 50 percent of the engines between 100 and 500 HP and 20 percent of the SI engines greater than 500 HP. All non-certified SI engines would require an initial compliance test. Certification values of $13 per engine for 100 to 300 HP engines, $32 per engine for 300 to 600 HP SI engines, and $153 per engine for

greater than 600 HP engines were used to estimate certification costs. These certification values were obtained from the nonroad regulatory support document (Reference 5) and converted to year 2005 dollars. An initial compliance testing cost of $1,000 was applied to each engine that is not certified. The initial testing cost is based on the test cost estimates using portable analyzers that were developed for the CI engine NSPS. The NSPS impacts for this category of engines also include the cost of notification and recordkeeping, which was estimated to be one hour per year at $68 per hour.

The cost impacts for natural gas fired rich burn SI engines were estimated assuming that rich burn engines greater than 50 HP would require the use of non-selective catalytic reduction (NSCR) to meet the emission standards. The annual cost equations for installing and operating a NSCR were obtained from the memorandum, "Control Costs for Reciprocating Internal Combustion Engines at Major and Area Sources (Reference 6)." Annual cost of installing and operating a NSCR were calculated for all rich burn engines greater than 50 HP, except for rich burn engines greater than 500 HP located at major sources. These engines are required to meet the requirements of the stationary internal combustion engine National Emission Standards for Hazardous Air Pollutants (NESHAP), which are based on the use of NSCR. The NSCR costs for these engines were accounted for in the impact costs for the NESHAP. The certification costs were estimated assuming that the engine manufacturers would certify 50 percent of the engines between 50 and 500 HP, and 20 percent of the SI engines greater than 500 HP. The year 2005 certification values from the nonroad regulatory support document (Reference 5) were $13 for 50 to 300 HP engines, $32 for 300 to 600 HP engines, and $153 for greater that 600 HP engines. Non-certified engines would require an initial compliance test, which was estimated to cost $1,000 per engine using a portable analyzer. The NSPS impacts for this category of engines also include the cost of notification and recordkeeping, which was estimated to be one hour per year at $68 per hour.

SI Engines All Sizes – Landfill Gas/Digester Gas

For SI engines firing landfill gas or digester gas, the SI NSPS requires the engines meet the Stage 1 and 2 emission standards in the NSPS. There should be no emission control devices needed to meet these standards based on emissions data for landfill gas engines. Therefore the cost impacts were calculated assuming the engine manufacturers would certify 50 percent of the engines between 50 and 500 HP, and 20 percent of the SI engines greater than 500 HP. EPA does not expect any landfill or digester gas engines below 50 HP. Certification costs, obtained from the nonroad regulatory support document (Reference 5), were estimated to be $13 for each 50 to 300 HP engine, $32 for each 300 to 600 HP engine, and $153 for each engine greater that 600 HP. Non-certified engines would require an initial compliance test, which was estimated to cost $1,000 per engine using a portable analyzer. The NSPS impacts for this category of engines include the cost of notification and recordkeeping, which was estimated to be one hour per year at $68 per hour.

SI Engines All Sizes – Emergency

For SI engines used for emergency purposes, the SI NSPS requires the engines meet the emission standards in the NSPS. The final emission standards for emergency engines below 130 HP are achievable by rich burn engines without aftertreatment; therefore no additional control cost was estimated for this group of engines. Based on information received post-proposal, EPA has learned that there are lean burn engines currently in the market down to 130 HP. For that reason, the final emission standards for engines greater than or equal to 130 HP can be met by lean burn engines, and no additional control cost was estimated for this category of engines. Therefore, only rich burn engines greater than or equal to 130 HP firing natural gas will need to add a control device to meet the emission standards. The cost of installing and operating a NSCR was added to these engines. Cost impacts were calculated assuming the engine manufacturers would certify 50 percent of emergency engines below 500 HP and 20 percent of the emergency SI engines greater than 500 HP. Cost of certification from the nonroad regulatory support document (Reference 5) was used to determine the certification values for the engines. Non-certified engines would require an initial compliance test, which was estimated to cost $1,000 per engine using a portable analyzer. The NSPS impacts for this category of engines include the cost of notification and recordkeeping, which was estimated to be one hour per year at $68 per hour.

4SLB Engines 250-500 HP Located at Major Sources

New and reconstructed engines that are 250 to 500 HP 4SLB SI engines located at major sources will be required to reduce emissions of carbon monoxide (CO) by 93 percent or limit the exhaust concentration of formaldehyde to 14 ppmvd. The number of engines in this subcategory was estimated by assuming that 40 percent of the projected new 250-500 HP 4SLB natural gas fired engines would be located at a major source. A cost of $3.58 per horsepower was used to estimate the annual cost of installing and operating an oxidation catalyst, and a cost of $20.5 per horsepower was used to estimate the capital cost of an oxidation catalyst (Reference 6). The capital cost of required testing and monitoring was estimated to be $13,479 per engine, and the annual cost was estimated to be $5,959 per engine (Reference 7). Recordkeeping and reporting costs are estimated to be $151 per year per engine (Reference 7). The testing, monitoring, recordkeeping, and reporting costs are based on the cost estimates developed in the Reciprocating Internal Combustion Engine (RICE) NESHAP. A summary of the costs converted to 2005 dollars is presented in Table 2.

Emission Reductions

The emission reductions associated with the SI NSPS were calculated using emission factors for SI engines provided by engine manufacturers (Reference 8) as the baseline emission rate, and comparing them to the NSPS emission standards. Emissions for all engines were calculated using 2,800 hours of operation per year. More than 90 percent

of the emission reductions are a result of installing NSCR on rich burn natural gas fired engines. The emission reductions for rich burn engines were calculated using the emission reduction capabilities of NSCR, which are 90 percent reduction of NO_X, 90 percent reduction of CO, 50 percent reduction of VOC, and 90 percent reduction of HAP. It was assumed that most of the other SI engines could meet the emission requirements in the SI NSPS without add-on control technology. For 250-500 HP 4SLB engines located at major sources the emission reductions are based on the requirements in the RICE NESHAP. The emission reductions for these engines are based on the use of an oxidation catalyst and were estimated to be 93 percent reduction for CO and 65 percent reduction for HAP. A summary of the emission reduction estimates is presented in Tables 3 and 4.

References

1. Memorandum from Bradley Nelson, Alpha-Gamma Technologies to Jaime Pagán, EPA OAQPS ESD Combustion Group. February 6, 2006. Non-methane Hydrocarbons as a surrogate for Hazardous Air Pollutants for Stationary Internal Combustion Engines.

2. Memorandum from Chuck Zukor, Alpha-Gamma Technologies to Jaime Pagán, EPA OAQPS ESD Combustion Group. April 13, 2004. Development of HAP Emission Factors for Small (≤500 HP) Stationary Reciprocating Internal Combustion Engines (RICE).

3. Memorandum from Tanya Parise, Alpha-Gamma Technologies to Sims Roy, EPA OAQPS ESD Combustion Group. September 1, 2005. Population and Projection of Stationary Spark Ignition Engines.

4. Information submittal from the Engine Manufacturers Association to Sims Roy, EPA OAQPS ESD Combustion Group. September 19, 2005. EMA Response to Questions on Proposed SI Engine NSPS.

5. EPA Office of Air and Radiation. Final Regulatory Support Document: Control of Emissions from Unregulated Nonroad Engines (EPA420-R-02-022)

6. Memorandum from Bradley Nelson, Alpha-Gamma Technologies to Jaime Pagán, EPA OAQPS ESD Combustion Group. August 1, 2005. Control Costs for Reciprocating Internal Combustion Engines at Major and Area Sources.

7. Memorandum from Tanya Ali and Melanie Taylor, Alpha-Gamma Technologies to Sims Roy, EPA OAQPS ESD Combustion Group. February 19, 2004. National Impacts Associated with the Final NESHAP for RICE.

8. Memorandum from Tanya Parise, Alpha-Gamma Technologies to Jaime Pagán, EPA OAQPS ESD Combustion Group. January 23, 2005. Emission Factors for Stationary Spark Ignition Engines.

Appendix A

Cost Impact Summaries by NAICS
Presented in Year 2005 Dollars

Summary of Total Costs Associated with the SI NSPS

Air Compressors, Gas Compressors (333912)

Type of Cost	2007	2008	2009	2010	2011	2012	2013	2014	2015
25-50 HP									
Control Capital Cost	0	0	0	0	0	0	0	0	0
Annual Control Cost	0	0	0	0	0	0	0	0	0
Engine Certification	0	666	711	734	757	781	804	828	851
Initial Compliance Test	0	37,764	40,013	41,330	42,647	43,964	45,281	46,598	47,915
Recordkeeping and Notification	0	5,991	6,372	6,582	6,792	7,002	7,211	7,421	7,631
Total Annual Cost	0	44,421	47,095	48,646	50,196	51,746	53,296	54,846	56,396
50-100 HP									
Control Capital Cost	0	0	505,197	503,060	500,923	498,786	496,650	494,513	492,376
Annual Control Cost	0	0	131,946	131,388	130,830	130,272	129,714	129,156	128,598
Engine Certification	0	1,521	1,561	1,555	1,548	1,542	1,535	1,528	1,522
Initial Compliance Test	0	86,672	88,486	88,112	87,738	87,364	86,989	86,615	86,241
Recordkeeping and Notification	0	13,709	14,041	13,981	13,922	13,863	13,803	13,744	13,684
Total Annual Cost	0	101,901	236,035	235,037	234,038	233,040	232,042	231,043	230,045
100-175 HP									
Control Capital Cost	0	1,799,392	1,863,918	1,868,015	1,872,111	1,876,207	1,880,303	1,884,399	1,888,495
Annual Control Cost	0	409,540	424,226	425,158	426,090	427,023	427,955	428,887	429,820
Engine Certification	0	5,432	5,608	5,617	5,626	5,635	5,645	5,654	5,663
Initial Compliance Test	0	310,500	318,760	319,274	319,789	320,303	320,818	321,332	321,847
Recordkeeping and Notification	0	49,026	50,494	50,576	50,657	50,739	50,820	50,902	50,984
Total Annual Cost	0	774,498	799,088	800,625	802,163	803,700	805,238	806,775	808,313
175-300 HP									
Control Capital Cost	0	1,343,203	1,433,722	1,453,546	1,473,370	1,493,194	1,513,019	1,532,843	1,552,667
Annual Control Cost	0	266,607	284,574	288,509	292,444	296,379	300,314	304,248	308,183
Engine Certification	0	4,148	4,342	4,402	4,462	4,522	4,582	4,642	4,703
Initial Compliance Test	0	272,383	242,643	245,998	249,353	252,708	256,063	259,418	262,773
Recordkeeping and Notification	0	39,836	38,813	39,349	39,886	40,423	40,960	41,496	42,033
Total Annual Cost	0	582,974	570,372	578,259	586,145	594,032	601,919	609,805	617,692
300-600 HP									
Control Capital Cost	102,991	2,278,561	2,510,244	2,599,505	2,688,765	2,778,026	2,867,287	2,956,548	3,045,809
Annual Control Cost	17,237	397,774	438,051	453,628	469,204	484,781	500,357	515,934	531,510
Engine Certification	317	6,521	6,952	7,199	7,446	7,693	7,941	8,188	8,435
Initial Compliance Test	39,661	372,117	311,806	322,893	333,980	345,068	356,155	367,243	378,330
Recordkeeping and Notification	13,643	41,469	38,370	39,734	41,099	42,463	43,827	45,192	46,556
Total Annual Cost	70,858	817,881	795,178	823,454	851,729	880,005	908,280	936,556	964,831
600-750 HP									
Control Capital Cost	30,596	165,220	159,328	138,944	118,560	98,176	77,792	57,408	37,024
Annual Control Cost	4,957	26,767	25,812	22,510	19,208	15,905	12,603	9,301	5,998
Engine Certification	378	1,345	1,220	1,064	908	752	596	440	284
Initial Compliance Test	9,860	27,769	25,372	22,126	18,880	15,634	12,388	9,142	5,896
Recordkeeping and Notification	3,392	2,981	2,706	2,360	2,014	1,668	1,321	975	629
Total Annual Cost	18,587	58,862	55,111	48,060	41,009	33,959	26,908	19,857	12,806
> 750 HP									
Control Capital Cost	741,813	4,628,822	5,227,926	5,420,993	5,614,060	5,807,127	6,000,194	6,193,261	6,386,329

Annual Control Cost	112,780	703,700	794,743	824,058	853,373	882,688	912,003	941,318	970,633
Engine Certification	11,433	33,022	34,854	36,119	37,385	38,650	39,916	41,181	42,447
Initial Compliance Test	298,354	731,168	774,388	802,474	830,560	858,646	886,732	914,817	942,903
Recordkeeping and Notification	71,706	73,221	77,309	80,116	82,923	85,730	88,537	91,344	94,151
Total Annual Cost	494,273	1,541,112	1,681,293	1,742,767	1,804,240	1,865,714	1,927,187	1,988,661	2,050,134
All 333912 SI Engines									
Control Capital Cost	875,400	10,215,197	11,700,336	11,984,063	12,267,790	12,551,518	12,835,245	13,118,973	13,402,700
Annual Control Cost	134,974	1,804,387	2,099,353	2,145,251	2,191,149	2,237,047	2,282,946	2,328,844	2,374,742
Engine Certification	12,128	52,654	55,248	56,691	58,133	59,576	61,018	62,461	63,903
Initial Compliance Test	347,875	1,838,373	1,801,467	1,842,207	1,882,946	1,923,686	1,964,425	2,005,165	2,045,904
Recordkeeping and Notification	88,741	226,233	228,105	232,699	237,293	241,886	246,480	251,074	255,668
Total Annual Cost	583,718	3,921,648	4,184,173	4,276,847	4,369,521	4,462,195	4,554,869	4,647,544	4,740,218
NESHAP 250-500 HP 4SLB									
Control Capital Cost	833,417	860,728	887,820	914,924	942,038	969,163	996,297	1,023,440	1,050,591
Annual Control Cost	145,685	150,459	155,195	159,933	164,673	169,414	174,157	178,902	183,648
Testing/Monitoring CC	1,589,315	1,637,945	1,686,172	1,734,405	1,782,645	1,830,891	1,879,143	1,927,400	1,975,662
Testing/Monitoring AC	702,628	724,128	745,448	766,772	788,099	809,428	830,760	852,094	873,431
Recordkeeping and Notification	17,804	18,349	18,890	19,430	19,970	20,511	21,051	21,592	22,133
Total Annual Cost	866,118	892,936	919,533	946,135	972,742	999,353	1,025,969	1,052,588	1,079,211

Summary of Total Costs Associated with the SI NSPS

Generator Sets, Hydro Power Units (335312)

Type of Cost	2007	2008	2009	2010	2011	2012	2013	2014	2015
25-50 HP									
Control Capital Cost	0	0	0	0	0	0	0	0	0
Annual Control Cost	0	0	0	0	0	0	0	0	0
Engine Certification	0	15,964	17,030	17,591	18,151	18,712	19,272	19,833	20,393
Initial Compliance Test	0	905,032	958,931	990,494	1,022,057	1,053,619	1,085,182	1,116,745	1,148,308
Recordkeeping and Notification	0	143,575	152,718	157,744	162,771	167,798	172,824	177,851	182,878
Total Annual Cost	0	1,064,571	1,128,679	1,165,829	1,202,979	1,240,129	1,277,279	1,314,429	1,351,578
50-100 HP									
Control Capital Cost	0	0	4,061,463	4,044,284	4,027,105	4,009,926	3,992,747	3,975,567	3,958,388
Annual Control Cost	0	0	1,060,765	1,056,278	1,051,792	1,047,305	1,042,818	1,038,331	1,033,844
Engine Certification	0	12,226	12,553	12,500	12,447	12,394	12,341	12,288	12,235
Initial Compliance Test	0	696,787	711,374	708,365	705,356	702,347	699,338	696,329	693,320
Recordkeeping and Notification	0	110,208	112,879	112,402	111,924	111,447	110,969	110,492	110,014
Total Annual Cost	0	819,221	1,897,571	1,889,545	1,881,519	1,873,492	1,865,466	1,857,440	1,849,413
100-175 HP									
Control Capital Cost	0	9,375,138	9,711,331	9,732,673	9,754,014	9,775,355	9,796,697	9,818,038	9,839,380
Annual Control Cost	0	2,133,772	2,210,289	2,215,146	2,220,004	2,224,861	2,229,718	2,234,575	2,239,433
Engine Certification	0	28,301	29,220	29,267	29,314	29,362	29,409	29,456	29,504
Initial Compliance Test	0	1,617,759	1,660,793	1,663,474	1,666,155	1,668,835	1,671,516	1,674,197	1,676,877
Recordkeeping and Notification	0	255,436	263,082	263,507	263,933	264,358	264,783	265,209	265,634
Total Annual Cost	0	4,035,268	4,163,384	4,171,395	4,179,405	4,187,416	4,195,426	4,203,437	4,211,448
175-300 HP									
Control Capital Cost	0	3,839,771	4,098,535	4,155,206	4,211,877	4,268,548	4,325,218	4,381,889	4,438,560
Annual Control Cost	0	762,142	813,503	824,752	836,000	847,248	858,497	869,745	880,994
Engine Certification	0	11,857	12,413	12,585	12,756	12,928	13,100	13,271	13,443
Initial Compliance Test	0	778,652	693,636	703,227	712,818	722,409	732,000	741,591	751,181
Recordkeeping and Notification	0	113,877	110,953	112,487	114,021	115,555	117,090	118,624	120,158
Total Annual Cost	0	1,666,528	1,630,505	1,653,050	1,675,595	1,698,140	1,720,686	1,743,231	1,765,776
300-600 HP									
Control Capital Cost	151,239	3,345,998	3,686,218	3,817,295	3,948,372	4,079,449	4,210,526	4,341,603	4,472,680
Annual Control Cost	25,312	584,119	643,265	666,138	689,012	711,886	734,759	757,633	780,507
Engine Certification	466	9,575	10,208	10,571	10,934	11,297	11,660	12,023	12,386
Initial Compliance Test	58,240	546,442	457,877	474,159	490,440	506,722	523,003	539,285	555,566
Recordkeeping and Notification	20,034	60,897	56,345	58,349	60,352	62,356	64,359	66,363	68,366
Total Annual Cost	104,052	1,201,033	1,167,696	1,209,217	1,250,739	1,292,261	1,333,783	1,375,304	1,416,826
600-750 HP									
Control Capital Cost	18,475	99,766	96,209	83,900	71,592	59,283	46,974	34,665	22,357
Annual Control Cost	2,993	16,163	15,587	13,593	11,598	9,604	7,610	5,616	3,622
Engine Certification	228	812	737	643	548	454	360	265	171
Initial Compliance Test	5,954	16,768	15,320	13,360	11,400	9,440	7,480	5,520	3,560
Recordkeeping and Notification	2,048	1,800	1,634	1,425	1,216	1,007	798	589	380
Total Annual Cost	11,224	35,543	33,278	29,021	24,763	20,506	16,248	11,991	7,733
> 750 HP									
Control Capital Cost	656,606	4,097,142	4,627,431	4,798,322	4,969,212	5,140,103	5,310,994	5,481,885	5,652,776

Annual Control Cost	99,826	622,871	703,456	729,404	755,352	781,300	807,248	833,195	859,143
Engine Certification	10,120	29,229	30,850	31,970	33,091	34,211	35,331	36,451	37,571
Initial Compliance Test	264,084	647,184	685,440	710,300	735,159	760,019	784,879	809,739	834,599
Recordkeeping and Notification	63,470	64,811	68,429	70,913	73,398	75,883	78,367	80,852	83,337
Total Annual Cost	437,500	1,364,095	1,488,175	1,542,587	1,597,000	1,651,412	1,705,825	1,760,237	1,814,650
All 335312 SI Engines									
Control Capital Cost	826,320	20,757,815	26,281,187	26,631,680	26,982,172	27,332,664	27,683,156	28,033,648	28,384,140
Annual Control Cost	128,131	4,119,066	5,446,865	5,505,311	5,563,758	5,622,204	5,680,650	5,739,096	5,797,542
Engine Certification	10,814	107,965	113,011	115,127	117,242	119,357	121,473	123,588	125,703
Initial Compliance Test	328,278	5,208,625	5,183,371	5,263,378	5,343,385	5,423,391	5,503,398	5,583,405	5,663,411
Recordkeeping and Notification	85,552	750,603	766,040	776,828	787,616	798,403	809,191	819,979	830,767
Total Annual Cost	552,775	10,186,260	11,509,288	11,660,644	11,812,000	11,963,356	12,114,712	12,266,068	12,417,424
NESHAP 250-500 HP 4SLB									
Control Capital Cost	1,654,821	1,702,515	1,749,737	1,796,946	1,844,145	1,891,334	1,938,513	1,985,683	2,032,845
Annual Control Cost	289,270	297,608	305,862	314,115	322,365	330,614	338,861	347,107	355,351
Testing/Monitoring CC	3,155,721	3,239,846	3,323,146	3,406,439	3,489,726	3,573,006	3,656,281	3,739,551	3,822,815
Testing/Monitoring AC	1,395,129	1,432,320	1,469,147	1,505,970	1,542,791	1,579,609	1,616,424	1,653,237	1,690,048
Recordkeeping and Notification	35,352	36,295	37,228	38,161	39,094	40,027	40,960	41,893	42,826
Total Annual Cost	1,719,752	1,766,222	1,812,237	1,858,246	1,904,250	1,950,250	1,996,245	2,042,236	2,088,224

Summary of Total Costs Associated with the SI NSPS

Pumps (333911)

Type of Cost	2007	2008	2009	2010	2011	2012	2013	2014	2015
25-50 HP									
Control Capital Cost	0	0	0	0	0	0	0	0	0
Annual Control Cost	0	0	0	0	0	0	0	0	0
Engine Certification	0	3,351	3,575	3,693	3,811	3,928	4,046	4,164	4,281
Initial Compliance Test	0	190,000	201,315	207,942	214,568	221,194	227,820	234,446	241,073
Recordkeeping and Notification	0	30,142	32,061	33,116	34,172	35,227	36,282	37,338	38,393
Total Annual Cost	0	223,493	236,952	244,751	252,550	260,349	268,149	275,948	283,747
50-100 HP									
Control Capital Cost	0	0	474,153	472,147	470,142	468,136	466,131	464,125	462,120
Annual Control Cost	0	0	123,838	123,315	122,791	122,267	121,743	121,219	120,695
Engine Certification	0	1,427	1,466	1,459	1,453	1,447	1,441	1,435	1,428
Initial Compliance Test	0	81,346	83,049	82,698	82,346	81,995	81,644	81,292	80,941
Recordkeeping and Notification	0	12,866	13,178	13,122	13,067	13,011	12,955	12,899	12,844
Total Annual Cost	0	95,639	221,531	220,594	219,657	218,720	217,783	216,846	215,909
100-175 HP									
Control Capital Cost	0	616,619	638,731	640,135	641,538	642,942	644,346	645,749	647,153
Annual Control Cost	0	140,342	145,374	145,694	146,013	146,333	146,652	146,972	147,291
Engine Certification	0	1,861	1,922	1,925	1,928	1,931	1,934	1,937	1,940
Initial Compliance Test	0	106,403	109,233	109,410	109,586	109,762	109,938	110,115	110,291
Recordkeeping and Notification	0	16,800	17,303	17,331	17,359	17,387	17,415	17,443	17,471
Total Annual Cost	0	265,406	273,833	274,360	274,887	275,414	275,940	276,467	276,994
175-300 HP									
Control Capital Cost	0	414	442	448	454	460	466	472	479
Annual Control Cost	0	82	88	89	90	91	93	94	95
Engine Certification	0	1	1	1	1	1	1	1	1
Initial Compliance Test	0	84	75	76	77	78	79	80	81
Recordkeeping and Notification	0	12	12	12	12	12	13	13	13
Total Annual Cost	0	180	176	178	181	183	186	188	190
300-600 HP									
Control Capital Cost	386	8,530	9,397	9,732	10,066	10,400	10,734	11,068	11,402
Annual Control Cost	65	1,489	1,640	1,698	1,757	1,815	1,873	1,931	1,990
Engine Certification	1	24	26	27	28	29	30	31	32
Initial Compliance Test	148	1,393	1,167	1,209	1,250	1,292	1,333	1,375	1,416
Recordkeeping and Notification	51	155	144	149	154	159	164	169	174
Total Annual Cost	265	3,062	2,977	3,083	3,189	3,294	3,400	3,506	3,612
600-750 HP									
Control Capital Cost	0	0	0	0	0	0	0	0	0
Annual Control Cost	0	0	0	0	0	0	0	0	0
Engine Certification	0	0	0	0	0	0	0	0	0
Initial Compliance Test	0	0	0	0	0	0	0	0	0
Recordkeeping and Notification	0	0	0	0	0	0	0	0	0
Total Annual Cost	0	0	0	0	0	0	0	0	0

> 750 HP									
Control Capital Cost	9,226	57,567	65,018	67,419	69,820	72,221	74,622	77,024	79,425
Annual Control Cost	1,403	8,752	9,884	10,249	10,613	10,978	11,342	11,707	12,071
Engine Certification	142	411	433	449	465	481	496	512	528
Initial Compliance Test	3,711	9,093	9,631	9,980	10,329	10,679	11,028	11,377	11,727
Recordkeeping and Notification	892	911	961	996	1,031	1,066	1,101	1,136	1,171
Total Annual Cost	6,147	19,166	20,910	21,674	22,439	23,203	23,968	24,732	25,497
All 333911 SI Engines									
Control Capital Cost	9,611	683,130	1,187,741	1,189,881	1,192,020	1,194,160	1,196,299	1,198,438	1,200,578
Annual Control Cost	1,467	150,665	280,824	281,044	281,264	281,484	281,703	281,923	282,143
Engine Certification	143	7,077	7,423	7,555	7,686	7,817	7,949	8,080	8,211
Initial Compliance Test	3,859	388,319	404,470	411,314	418,157	425,000	431,843	438,686	445,529
Recordkeeping and Notification	943	60,887	63,660	64,727	65,795	66,863	67,930	68,998	70,066
Total Annual Cost	6,412	606,947	756,378	764,640	772,902	781,163	789,425	797,687	805,949
NESHAP 250-500 HP 4SLB									
Control Capital Cost	2,055	2,138	2,222	2,305	2,388	2,471	2,555	2,638	2,722
Annual Control Cost	359	374	388	403	417	432	447	461	476
Testing/Monitoring CC	3,919	4,069	4,219	4,369	4,519	4,669	4,819	4,969	5,119
Testing/Monitoring AC	1,732	1,799	1,865	1,931	1,998	2,064	2,130	2,197	2,263
Recordkeeping and Notification	44	46	47	49	51	52	54	56	57
Total Annual Cost	2,136	2,218	2,301	2,383	2,466	2,548	2,631	2,713	2,796

Summary of Total Costs Associated with the SI NSPS

Welders (333992)

Type of Cost	2007	2008	2009	2010	2011	2012	2013	2014	2015
25-50 HP									
Control Capital Cost	0	0	0	0	0	0	0	0	0
Annual Control Cost	0	0	0	0	0	0	0	0	0
Engine Certification	0	847	904	934	964	993	1,023	1,053	1,083
Initial Compliance Test	0	48,042	50,904	52,579	54,255	55,930	57,606	59,281	60,956
Recordkeeping and Notification	0	7,621	8,107	8,374	8,640	8,907	9,174	9,441	9,708
Total Annual Cost	0	56,511	59,914	61,887	63,859	65,831	67,803	69,775	71,747
50-100 HP									
Control Capital Cost	0	0	1,177,999	1,173,016	1,168,033	1,163,051	1,158,068	1,153,085	1,148,103
Annual Control Cost	0	0	307,668	306,366	305,065	303,763	302,462	301,161	299,859
Engine Certification	0	3,546	3,641	3,626	3,610	3,595	3,579	3,564	3,549
Initial Compliance Test	0	202,098	206,329	205,456	204,584	203,711	202,838	201,965	201,093
Recordkeeping and Notification	0	31,965	32,740	32,601	32,463	32,324	32,186	32,047	31,909
Total Annual Cost	0	237,609	550,377	548,049	545,721	543,393	541,065	538,737	536,409
100-175 HP									
Control Capital Cost	0	51,943	53,805	53,924	54,042	54,160	54,278	54,397	54,515
Annual Control Cost	0	11,822	12,246	12,273	12,300	12,327	12,354	12,381	12,408
Engine Certification	0	157	162	162	162	163	163	163	163
Initial Compliance Test	0	8,963	9,202	9,216	9,231	9,246	9,261	9,276	9,291
Recordkeeping and Notification	0	1,415	1,458	1,460	1,462	1,465	1,467	1,469	1,472
Total Annual Cost	0	22,357	23,067	23,111	23,156	23,200	23,245	23,289	23,333
175-300 HP									
Control Capital Cost	0	0	0	0	0	0	0	0	0
Annual Control Cost	0	0	0	0	0	0	0	0	0
Engine Certification	0	0	0	0	0	0	0	0	0
Initial Compliance Test	0	0	0	0	0	0	0	0	0
Recordkeeping and Notification	0	0	0	0	0	0	0	0	0
Total Annual Cost	0	0	0	0	0	0	0	0	0
300-600 HP									
Control Capital Cost	0	0	0	0	0	0	0	0	0
Annual Control Cost	0	0	0	0	0	0	0	0	0
Engine Certification	0	0	0	0	0	0	0	0	0
Initial Compliance Test	0	0	0	0	0	0	0	0	0
Recordkeeping and Notification	0	0	0	0	0	0	0	0	0
Total Annual Cost	0	0	0	0	0	0	0	0	0
600-750 HP									
Control Capital Cost	0	0	0	0	0	0	0	0	0
Annual Control Cost	0	0	0	0	0	0	0	0	0
Engine Certification	0	0	0	0	0	0	0	0	0
Initial Compliance Test	0	0	0	0	0	0	0	0	0
Recordkeeping and Notification	0	0	0	0	0	0	0	0	0
Total Annual Cost	0	0	0	0	0	0	0	0	0

> 750 HP									
Control Capital Cost	0	0	0	0	0	0	0	0	0
Annual Control Cost	0	0	0	0	0	0	0	0	0
Engine Certification	0	0	0	0	0	0	0	0	0
Initial Compliance Test	0	0	0	0	0	0	0	0	0
Recordkeeping and Notification	0	0	0	0	0	0	0	0	0
Total Annual Cost	0	0	0	0	0	0	0	0	0
All 333992 SI Engines									
Control Capital Cost	0	51,943	1,231,804	1,226,940	1,222,075	1,217,211	1,212,346	1,207,482	1,202,617
Annual Control Cost	0	11,822	319,914	318,639	317,365	316,090	314,816	313,541	312,267
Engine Certification	0	4,550	4,707	4,721	4,736	4,751	4,765	4,780	4,795
Initial Compliance Test	0	259,104	266,434	267,252	268,069	268,887	269,705	270,522	271,340
Recordkeeping and Notification	0	41,002	42,304	42,435	42,566	42,696	42,827	42,958	43,088
Total Annual Cost	0	316,478	633,359	633,047	632,736	632,424	632,113	631,801	631,489
NESHAP 250-500 HP 4SLB									
Control Capital Cost	0	0	0	0	0	0	0	0	0
Annual Control Cost	0	0	0	0	0	0	0	0	0
Testing/Monitoring CC	0	0	0	0	0	0	0	0	0
Testing/Monitoring AC	0	0	0	0	0	0	0	0	0
Recordkeeping and Notification	0	0	0	0	0	0	0	0	0
Total Annual Cost	0	0	0	0	0	0	0	0	0

Appendix B

Emission Reduction Summaries by Horsepower

Summary of Emission Reductions (tpy) Associated with the SI NSPS - By Size (HP)				
	NOx	**CO**	**NMHC**	**HAP**
2007				
25-50 HP	0	0	0	0
50-100	0	0	0	0
100-175	0	0	0	0
175-300	0	0	0	0
300-500	0	0	0	0
500-600	1,341	385	23	9
600-750	256	77	5	2
750-1200	5,146	2,078	89	33
1200-2000	2,335	995	32	12
>2000	0	0	0	0
Total	**9,078**	**3,534**	**149**	**56**
2008				
25-50 HP	3,678	2,263	32	12
50-100	5,964	3,957	45	17
100-175	14,681	8,704	180	68
175-300	7,769	3,505	135	51
300-500	6,602	1,776	109	41
500-600	2,784	798	49	18
600-750	461	138	8	3
750-1200	10,687	4,316	184	69
1200-2000	4,872	2,077	67	25
>2000	0	0	0	0
Total	**57,496**	**27,533**	**811**	**304**
2009				
25-50 HP	3,837	2,381	34	13
50-100	5,997	4,009	45	17
100-175	15,207	9,016	181	68
175-300	8,292	3,741	137	51
300-500	7,205	1,938	113	42
500-600	3,139	900	50	19
600-750	444	133	7	3
750-1200	12,054	4,868	191	72
1200-2000	5,519	2,353	70	26
>2000	0	0	0	0
Total	**61,695**	**29,338**	**828**	**311**
2010				
25-50 HP	3,963	2,459	35	13
50-100	5,972	3,992	81	30
100-175	15,241	9,134	326	122
175-300	8,407	3,876	250	94

300-500	7,461	2,072	210	79
500-600	3,509	1,243	94	35
600-750	419	155	12	4
750-1200	13,550	6,488	395	148
1200-2000	6,231	3,322	215	81
>2000	50	193	0	0
Total	**64,804**	**32,741**	**1,617**	**606**
2011				
25-50 HP	4,090	2,537	36	13
50-100	6,382	4,846	80	30
100-175	16,594	11,793	439	165
175-300	9,679	5,369	305	114
300-500	8,620	3,435	252	95
500-600	3,896	1,562	97	36
600-750	385	160	10	4
750-1200	15,119	8,019	449	168
1200-2000	6,981	4,125	310	116
>2000	104	237	0	0
Total	**71,850**	**42,083**	**1,979**	**742**
2012				
25-50 HP	4,216	2,616	37	14
50-100	6,355	4,826	80	30
100-175	16,629	11,818	440	165
175-300	9,810	5,441	309	116
300-500	8,906	3,549	261	98
500-600	4,026	1,614	100	38
600-750	319	133	8	3
750-1200	15,622	8,285	464	174
1200-2000	7,238	4,278	322	121
>2000	107	244	0	0
Total	**73,228**	**42,802**	**2,021**	**758**
2013				
25-50 HP	4,342	2,694	38	14
50-100	6,327	4,805	80	30
100-175	16,665	11,843	441	165
175-300	9,940	5,513	313	118
300-500	9,192	3,663	269	101
500-600	4,155	1,666	103	39
600-750	253	105	6	2
750-1200	16,125	8,552	479	180
1200-2000	7,496	4,430	333	125
>2000	110	251	0	0
Total	**74,606**	**43,521**	**2,062**	**773**

2014				
25-50 HP	4,469	2,772	39	15
50-100	6,300	4,784	79	30
100-175	16,701	11,867	441	166
175-300	10,070	5,585	317	119
300-500	9,479	3,777	277	104
500-600	4,284	1,718	107	40
600-750	186	77	5	2
750-1200	16,627	8,818	494	185
1200-2000	7,754	4,583	344	129
>2000	113	258	0	0
Total	**75,984**	**44,240**	**2,104**	**789**
2015				
25-50 HP	4,595	2,851	40	15
50-100	6,273	4,764	79	30
100-175	16,737	11,892	442	166
175-300	10,200	5,658	322	121
300-500	9,765	3,891	286	107
500-600	4,414	1,769	110	41
600-750	120	50	3	1
750-1200	17,130	9,085	509	191
1200-2000	8,012	4,735	356	133
>2000	116	265	0	0
Total	**77,362**	**44,959**	**2,146**	**805**

Appendix C

Baseline Emissions Summaries by Horsepower

Summary of Baseline Emissions (tpy) Associated with the SI NSPS - By Size (HP)				
	NOx	**CO**	**NMHC**	**HAP**
2007				
25-50	3,998	3,525	65	25
50-100	7,340	6,491	121	46
100-175	18,390	16,281	863	324
175-300	10,657	8,658	805	302
300-500	8,464	5,056	509	191
500-600	4,089	2,837	382	143
600-750	789	563	76	28
750-1200	15,997	13,005	1,646	617
1200-2000	8,635	9,064	1,729	648
>2000	1,655	3,395	862	323
Total	**80,013**	**68,875**	**7,059**	**2,647**
2008				
25-50	4,139	3,650	68	25
50-100	7,308	6,463	121	45
100-175	18,429	16,313	864	324
175-300	10,810	8,783	816	306
300-500	8,791	5,252	528	198
500-600	4,242	2,944	397	149
600-750	710	507	68	26
750-1200	16,613	13,505	1,710	641
1200-2000	9,009	9,456	1,804	677
>2000	1,706	3,500	889	333
Total	**81,757**	**70,372**	**7,265**	**2,724**
2009				
25-50	4,279	3,774	70	26
50-100	7,277	6,435	120	45
100-175	18,468	16,346	865	324
175-300	10,961	8,906	828	310
300-500	9,115	5,445	548	205
500-600	4,399	3,052	411	154
600-750	629	449	60	23
750-1200	17,227	14,004	1,773	665
1200-2000	9,384	9,849	1,879	705
>2000	1,761	3,612	918	344
Total	**83,500**	**68,261**	**6,554**	**2,458**
2010				
25-50	4,420	3,898	72	27
50-100	7,246	6,408	120	45
100-175	18,507	16,378	866	325
175-300	11,113	9,029	839	315

300-500	9,439	5,639	567	213
500-600	4,555	3,161	426	160
600-750	549	392	53	20
750-1200	17,840	14,503	1,836	688
1200-2000	9,758	10,242	1,954	733
>2000	1,815	3,724	946	355
Total	**85,243**	**69,649**	**6,733**	**2,525**
2011				
25-50	4,561	4,022	75	28
50-100	7,216	6,381	119	45
100-175	18,546	16,410	867	325
175-300	11,264	9,152	850	319
300-500	9,763	5,833	587	220
500-600	4,712	3,270	440	165
600-750	468	334	45	17
750-1200	18,454	15,001	1,899	712
1200-2000	10,132	10,635	2,029	761
>2000	1,870	3,836	974	365
Total	**86,986**	**74,874**	**7,886**	**2,957**
2012				
25-50	4,702	4,146	77	29
50-100	7,185	6,354	119	45
100-175	18,585	16,443	868	326
175-300	11,416	9,275	862	323
300-500	10,087	6,026	606	227
500-600	4,868	3,378	455	171
600-750	388	277	37	14
750-1200	19,067	15,500	1,962	736
1200-2000	10,506	11,027	2,104	789
>2000	1,924	3,948	1,003	376
Total	**88,729**	**76,374**	**8,093**	**3,035**
2013				
25-50	4,843	4,271	79	30
50-100	7,154	6,327	118	44
100-175	18,624	16,475	869	326
175-300	11,567	9,399	873	328
300-500	10,411	6,220	626	235
500-600	5,025	3,487	470	176
600-750	307	219	29	11
750-1200	19,681	15,999	2,025	759
1200-2000	10,880	11,420	2,179	817
>2000	1,979	4,059	1,031	387
Total	**90,472**	**77,875**	**8,300**	**3,113**

2014				
25-50	4,984	4,395	82	31
50-100	7,123	6,299	118	44
100-175	18,663	16,507	870	326
175-300	11,719	9,522	885	332
300-500	10,736	6,413	645	242
500-600	5,181	3,595	484	182
600-750	227	162	22	8
750-1200	20,294	16,497	2,088	783
1200-2000	11,255	11,813	2,254	845
>2000	2,034	4,171	1,060	397
Total	**92,215**	**79,375**	**8,507**	**3,190**
2015				
25-50	5,125	4,519	84	31
50-100	7,093	6,272	117	44
100-175	18,702	16,540	871	327
175-300	11,871	9,645	896	336
300-500	11,060	6,607	665	249
500-600	5,337	3,704	499	187
600-750	146	104	14	5
750-1200	20,908	16,996	2,151	807
1200-2000	11,629	12,206	2,329	873
>2000	2,088	4,283	1,088	408
Total	**93,958**	**80,876**	**8,714**	**3,268**